Workshop: Tools for Addressing Groundwater-Surface Water Connectivity under the Sustainable Groundwater Management Act

Date: March 12, 2017
Location: Stanford Y2E2 Room 299

Overview

Contrary to science, California water law views and regulates surface water and groundwater as separate entities. Passage of the Sustainable Groundwater Management Act (SGMA) requires, for the first time in California's history, agencies managing groundwater to assess the impacts of groundwater pumping on water supply, surface water flows, and all beneficial water users.[1] These requirements, outlined in Table 1, represent a significant step forward for water management in California. However, because groundwater-surface water connectivity has not been a common management consideration in California, there are inadequate data or models in many groundwater basins about the degree of connectivity between these systems. Thus, meeting legislative requirements related to interconnected surface water[2] may be hindered by the lack of information about both the location and timing connectivity between surface waters and the groundwater basins underlying them as well as the many beneficial users that they support.

Research conducted by The Nature Conservancy (TNC) provides information on the effects of groundwater pumping on hydrologic conditions in California's agriculturally dominated Central Valley.[3] While this study provides baseline information on surface water connectivity in river systems throughout California's Central Valley, these data are limited in several key ways. First, the model use data for the period from 1922 to 2009, meaning that the analysis ended prior to California's most recent and severe drought. Thus, many basins may have experienced significant changes in the connectivity between their surface water and groundwater systems. Second, despite the rigor of the investigations undertaken by TNC and its consultants during this analysis, it does not contain information on the temporal variability in the connectivity of systems.

Of additional concern in California are perched aquifer systems: In regions where the water table of unconfined regional aquifers have disconnected from surface water, shallow perched aquifers can regulate recharge to deeper aquifers, diminish seepage losses and support gaining conditions in streams that can contribute an important groundwater supply for beneficial users that would otherwise be isolated from deeper, regional aquifers (Fleckenstein, Niswonger, & Fogg, 2006; Niswonger & Fogg, 2008; Palkovics, Petersen, & Matelski, 1975; Rassam, Fellows, De Hayr, Hunter, & Bloesch, 2006). While locally important,

[1] The California Department of Water Resources assigns all 515 of California's alluvial groundwater basins to one of four categories. These categories are high, medium, low, and very low. Groundwater basins designated as medium and high priority basins are subject to SGMA and must develop groundwater sustainability plans.
[2] The Sustainable Groundwater Management Act defines interconnected surface water as "surface water that is hydraulically connected at any point by a continuous zone to the underlying aquifer and the overlying surface water is not completely depleted." (CCR§ 351(o)).
[3] The Nature Conservancy. 2014. Groundwater and Stream interaction in California's Central Valley: Insights for Sustainable Groundwater Management. Available at: https://www.scienceforconservation.org/products/sustainable-groundwater-management-lessons

small-scale perched aquifers can be difficult to capture in regional-scale groundwater numerical models typically used by water managers.

Given the dearth of information about groundwater surface water connectivity and the relatively short timelines associated with the development of groundwater sustainability plans (GSPs) under SGMA,[4] there is a real and immediate need for tools or methods that can help agencies assess surface water connectivity in their basin and target management actions to the areas of highest priority in their basin. Many agencies, nongovernmental organizations, and academic institutions throughout California and beyond are working to develop tools or methods to assess interconnected surface water as it relates to SGMA. Table 2 provides a non-exhaustive compilation of these methods.

Methods and tools from other jurisdictions could also be applied in California. The most prominent online, conjunctive, management screening tool to date is the State of Michigan's Water Withdrawal Assessment Tool (see link), developed to prevent adverse resource impacts, improve public understanding of groundwater withdrawal impacts, minimize water use conflicts, and facilitate planning for sustainable water use (Hamilton and Seelbach, 2011; Miller, 2008; Reeves et al., 2009). The Water Withdrawal Assessment Tool was a significant advance in interactive and conjunctive groundwater and surface water management, since it explicitly considers low flows, the thermal regimes that support fish populations and multiple withdrawal sources. However, the data and output of the tool is applicable solely for the State of Michigan. In British Columbia, Canada, Foundry Spatial has developed a series of interactive, user-friendly water management tools (see link) that are being used extensively for surface water management. Recently, Foundry Spatial and University of Victoria have partnered to develop an interactive, user-friendly tool for conjunctive water management, already tested in watersheds and aquifers in British Columbia. The tool uses analytical solutions of streamflow depletion from groundwater pumping in a screening-level, decision-support tool.

Water in the West, University of Victoria, Foundry Spatial, The Nature Conservancy, and the Environmental Defense Fund are co-hosting this **Groundwater-Surface Water Tools Workshop** to explore tools and methods that could be developed for GSAs with interconnected surface waters.

Workshop goals

(1) Engage with individuals and entities working on groundwater and surface water connectivity and groundwater dependent ecosystems under SGMA;
(2) Examine recent research and tool development to assess research gaps and areas to coordinate or collaborate research effort to help address surface water depletions under SGMA; and
(3) Where new research or tools are necessary, identify their potential role in water management decisions, the data needs, essential functionality, and potential users, locations and partners for pilot studies.

[4] Groundwater Sustainability Plans (GSPs) must be completed by January 2020 for the 21 groundwater basins that the California Department of Water Resources (DWR) has designated as being in a state of critical overdraft. GSPs for all remaining high and medium priority basins must be completed by January 2022.

Legal and regulatory requirements related surface water connectivity under SGMA

Table 1. Legal and regulatory requirements for surface water connectivity under the Sustainable Groundwater Management Act

LEGAL REQUIREMENTS
GSPs must:
avoid chronic lowering of groundwater levels that result in significant and unreasonable depletion of supply (CWC 10721(w)(1))
avoid depletions of interconnected surface waters that have significant and unreasonable adverse impacts on beneficial uses of the surface water (CWC 10721(w)(6))
include impacts on GDEs (CWC 10727.4(l))
develop monitoring and management protocols to detect changes in surface flow… (CWC 10727.2(d)(2))
REGULATORY REQUIREMENTS
GSPs must:
include a hydrogeologic conceptual model characterizing surface water-groundwater interactions (CCR 354.14)
identify interconnected surface waters in the basin, including estimates of quantity and timing of depletions (CCR 354.16(f))
include water budgets that include estimates of inflows and outflows to and from the groundwater systems by and to surface water systems (354.18(b) (2&3)); historical and projected groundwater and surface water interactions using a numerical model or an equally effective method, tool, or analytical model (CCR 354.18(e))
include minimum thresholds for depletions of interconnected surface water that avoid undesirable results. Minimum thresholds must consider the location, quantity, and timing of depletions (CCR 354.28(c)(6)(A))
a description of the groundwater and surface water model used to quantify surface water depletion. If a model is not used the Plan must identify and describe an equally effective method, tool, or analytical model (CCR 354.28(c)(6)(B))
include a monitoring network capable of demonstrating the hydraulic gradients between principal aquifers and surface water features using monitoring wells (CCR 354.34(c)(1)); characterizing spatial and temporal exchanges between surface water and groundwater, and sufficiently calibrate models used to determine the impact of groundwater pumping on surface water depletions (CCR 354.35(c)(6))
evaluate and modify monitoring protocols to ensure that adequate detail about "site-specific" surface water and groundwater conditions and assess the effectiveness of management actions including in highly variable spatial and temporal conditions (CCR 354.38)

Existing work on groundwater surface water interactions in California and beyond

Table 2. Some existing tools, approaches, and data used to assess to interconnected surface water.

Method/Tool/Dataset	Affiliation	Contact	Description/URL
APPROACHES/REPORTS			
EDF's Proposed Approach for Compliance with Surface Water Depletion Requirements in SGMA	Environmental Defense Fund	Maurice Hall	Focuses on monitoring of groundwater levels in wells close to interconnected surface water bodies. Documentation available soon.
Groundwater dependent ecosystems Under SGMA: Guidance for Preparing GSPs	The Nature Conservancy	Melissa Rohde	https://www.scienceforconservation.org/assets/downloads/GDEsUnderSGMA.pdf
Study on the effects of groundwater pumping	The Nature Conservancy	Jeanette Howard	https://www.scienceforconservation.org/products/sustainable-groundwater-management-lessons
Unimpaired flow analysis	The Nature Conservancy	Julie Zimmerman	http://onlinelibrary.wiley.com/doi/10.1111/fwb.13058/full
Navigating Groundwater-Surface Water Interactions under the Sustainable Groundwater Management Act	UC Water	Michael Kiparsky	Report focusing on the legal and technical dimensions of groundwater-surface water interactions under SGMA; to be released in March, 2018.
DATASETS			
California Statewide Groundwater Elevation Monitoring (CASGEM) Program	Department of Water Resources	Tom Lutterman	https://www.water.ca.gov/Programs/Groundwater-Management/Groundwater-Elevation-Monitoring--CASGEM
Stream gauging network	U.S. Geological Survey		https://waterdata.usgs.gov/ca/nwis/rt
Gage Gap Tool – An analysis of California's stream Gage Network	The Nature Conservancy	Jeanette Howard	https://gagegap.codefornature.org/
MODELS			
Analytical-Numerical Model Comparison	University of Victoria	Tom Gleeson	https://eartharxiv.org/mdn3h
Coupled spatiotemporally distributed water budget with stream-depletion functions	UC Davis	Laura Fogila	http://onlinelibrary.wiley.com/doi/10.1002/wrcr.20555/abstract
TOOLS			
The B.C. and Alberta Water Tools	Foundry Spatial	Ben Kerr	• https://water.bcogc.ca/newt • http://cariboo.bcwatertool.ca/watershed • https://alberta-watertool.com/
The Michigan Tool	Michigan Dept. of Water Quality and U.S. Geological Survey	Howard Reeves	http://www.deq.state.mi.us/wwat/(S(gftfzddefwjrsh1noycw3pw0))/default.aspx

Potential workshop outputs

We would like to hear from you about what would be most useful with respect to workshop outputs! Our goal is to develop materials to support the development of sustainable groundwater management plans under SGMA.

Thus, some initial thoughts for workshop outputs and follow up meetings, include:

1. **Working groups:** Convening small, focused workgroup session to explore the development of specific tools or approaches, pilot studies, or integration of approaches;
2. **Methods table:** Developing a table providing an overview of tools, methods, and approaches for assessing interconnected surface water. This table could include an overview of the most suitable applications of each approach, benefits, limitations, costs, and case studies. If deemed useful, we would welcome your feedback on 1) how to make this table most useful i.e., categories to include, and 2) your expertise in developing it.

   Melissa Rohde has already taken a first stab at such a table (Thank you, Melissa!), which you can link to or edit here. We will be soliciting your feedback throughout the workshop, but please reach out to Melissa Rohde (melissa.rohde@tnc.org) directly if you have specific comments on the table or would like to contribute to its development.

References

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